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The Change Trend and Guidance Education of Sports Aesthetics under the Trend of Sports Art

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Abstract. In order to improve the accuracy of sports aesthetics evaluation, an evaluation method for sports aesthetics based on the MULCA algorithm of rough set entropy attribute reduction under the trend of sports art is proposed. First, the aesthetics evaluation index system based on rough set is built and the sports aesthetics index classification standard table is given, to classify sports art aesthetics as 5 levels; secondly, the important measure weight distance of entropy is used to replace Euclidean distance, to calculate individual similarity and achieve effective connection of rough set output data and sports art aesthetic level classification, so as to realize the improvement of evaluation accuracy at the same time of reducing evaluation calculation; finally, the effectiveness of the proposed evaluation method of sports aesthetics is verified through simulation experiments.

Key words. Sports art Rough set Attribute reduction Important measure of entropy Classification.

1. Introduction

Sports aesthetics should be supposed to be a new discipline, although it is not very long in the history of development, when it is incorporated into the development of post industrial society for study, it will be found that sports aesthetics will change in many aspects somewhat. Therefore, the word "post" is used here, and its meaning mainly lies in that: firstly, according to the "postmodernism" and the critical attitude held by postmodernism towards modernism, participate in the discussion of sports aesthetics; secondly, it is necessary to give some explanation because the science and technology, the core factors in the "post industrial society" in the "post modernity" directly or indirectly affect the development of sports aesthetics; more importantly, the author hopes to attract attention and continuous research of colleagues through this proposal.

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Weiner, an American scientist, said: “the field which can get the greatest harvest in the scientific development, is the neglected no-man’s land between departments that have been established”. Sports aesthetics came into being in this land. It’s appearance first benefited from the inherent requirements of its own development, followed by the expectations needed by the society and people. Sports aesthetics, like other interdisciplines, has found the common discussion problem among the departments which are associated originally. The background knowledge of two or more disciplines in the common field is prepared, nurtured and integrated to form an independent interdiscipline. But no matter how to keep the independence, the sports aesthetics can also not get rid of the influences of donor discipline on it, so that the sports aesthetics has a relatively independent meaning, namely, its discipline attribute will not maintain “neutral” completely, always has the focus, or partial to aesthetic category, or to the sports category. Exactly, the problem is that the construction of sports aesthetics is attributable to aesthetics or sports on earth? In the opinion of the author, it is more appropriate to classify sports aesthetics as sports science research, because the research object of sports aesthetics is the aesthetic relationship between man and sports.

For the aesthetics of different scenic sports, their landscape characteristics are not the same, although the evaluation indexes are the same, the weights are not necessarily identical, so it is unreasonable to determine the weights by the traditional methods (such as AHP). Therefore, it attempts to introduce the rough set theory (RoughSet), a mathematical theory for data analysis proposed by Pawlak(1995), a Poland mathematician in 1982, on the basis of sports aesthetics evaluation method. The application of rough set theory in sports art aesthetics evaluation is preliminarily discussed by evaluating sports art aesthetics based on discernibility matrix and logic operation (Pawlak, 1984).

2. Evaluation index system of sports art aesthetics

Rough set is a mathematical theory of data analysis which was first proposed by Z.Pawlak, a Poland mathematician in 1980s. It is a mathematical tool to describe the incompleteness and uncertainty. He thinks that people’s understanding of the research object is based on the knowledge system. If the knowledge system is improved, people’s understanding will be more profound; on the contrary, it is relatively rough. However, knowledge is a kind of classification of the research object by people. According to the classification principle, the research object is divided into several equivalence classes - “particles”. Any concept about the research object can apply the collection of these “particles”, which is either accurate or inaccurate, that is rough. The cause of roughness is understood as insufficient information or knowledge. Based on this, rough set theory has been used to study the expression, learning and inductive theory and method of various imprecise, inconsistent and incomplete knowledge and information. Without needing priori knowledge, it can simplify the data and solve the minimum expression of knowledge only by using the information provided by the data itself, under the premise of retaining the key information; it can identify and evaluate the dependence between data, to reveal the model of simple concept; and can acquire the rule knowledge that is easily confirmed from experiential data. At present, rough set has become a new academic hotspot in the field of information and artificial intelligence. The vitality of rough set theory lies in its strong practicability, and it has made encouraging achievements in many fields such as machine learning, knowledge acquisition, pattern recognition, fault diagnosis, decision analysis and process control from birth to now (Zhang Wenxiu, 2001). The rough set theory is introduced to calculate the weight of each index by using the concept of its attribute importance.

The standard of sports aesthetics is measured on the basis of sports art aesthetics evaluation index. By the scores of indexes of the sports art aesthetics evaluation system multiplied by its weight, its accumulated value is defined as sports aesthetics index. The graceful degree of sports aesthetics is measured according to the size of sports aesthetic index. Sports aesthetic indexes are set as 10 points system, and provided with different points according to the weight of each index. Therefore, according to the size of sports aesthetics index, the level of sports art aesthetics is divided into 5 classes, I, II, III, IV and V, respectively represents very beautiful, beautiful, general, poor and very poor. The classification results are shown in Table 1.

Table 1. Classification standard of sports aesthetic index

Sports aesthetic class	Sports aesthetic index	Remarks
I	9∼10	Very beautiful
II	7∼9	Beautiful
III	6∼7	General
IV	3∼6	Poor
V	0∼3	Very poor

3. MULCA(RSMULCA)MULCA (RSMULCA) based on rough set entropy attribute reduction

3.1. Basic theory of rough set

Rough set theory [4] is a theory used for processing imprecise, incomplete and uncertain data, which can effectively analyze imprecise, inconsistent and incomplete information, and is a powerful tool for data reasoning. It mainly has the following advantages: only dependent on the original data, without the need for any external information and prior information, such as probability distribution in the statistics, membership in fuzzy set theory, etc., so it can be said that its description or processing for the uncertainty of the problem is relatively objective.

Although other mathematical methods of dealing with imprecise and vague problems are the same to solve the approximate values, such as fuzzy set and evidence theory, etc., but the difference is that for the rough set, the approximate value is calculated by using mathematical formula, while for the fuzzy set theory, the approximate result can only be solved relying on statistical methods; it is not only suitable for the analysis of quality attributes, but also applicable to the analysis of quantity attributes; redundant attributes are reduced and the reduction algorithm is relatively simple, and the minimum knowledge representation is given by decision rule derived from the rough set model; no correction is made to inconsistency, and the generated inconsistent rules are divided into certainty rules and possibility rules; derived results are easy to be understood, etc.; anomalies in data can be found and noise interference in the process of knowledge discovery can be eliminated; be beneficial for concurrent execution, and improve the discovery efficiency; compared with the fuzzy set method or neural networks method, decision rules and reasoning process derived from rough set method is easier to be proved and explained.

given a knowledge representation system $S = (U, A, V, f), P \subseteq A, X \subseteq U, x \in U$, the lower approximation, upper approximation, negative zone, boundary zone and approximate accuracy of set X regarding I are respectively

$$\underline{apr}_P(X) = \bigcup \{x \in U : I(x) \subseteq X\}\,. \tag{1}$$

$$\overline{apr}_P(X) = \bigcup \{x \in U : I(x) \cap X \neq \Phi\}\,. \tag{2}$$

$$neg_P(X) = \bigcup \{x \in U : I(x) \cap X = \Phi\}\,. \tag{3}$$

$$bnd_P(X) = \overline{apr}_P(X) - \underline{apr}_P(X)\,. \tag{4}$$

$$\alpha_P(X) = \frac{|\underline{apr}_P(X)|}{|\overline{apr}_P(X)|}\,. \tag{5}$$

According to the definition of the rough fuzzy set [6], it can be known that for fuzzy set FX,

$$\underline{apr}_P(FX) = \bigcup \{x \in U : \mu_{FX}(x) = 1\}\,. \tag{6}$$

$$\overline{apr}_P(FX) = \bigcup \{x \in U : \mu_{FX}(x) > 0\}\,. \tag{7}$$

Then according to the definition of the rough fuzzy set [7], it can be known that

$$\ker(FX) = \underline{apr}_P(FX)\,. \tag{8}$$

$$\sup p(FX) = \overline{apr}_P(FX)\,. \tag{9}$$

According to the definition of rough membership function and variable precision rough set model [8], it can be known that for random variable SX,

$$\underline{apr}_P(SX) = \bigcup \{x \in U : \mu_{SX}(x) \geq \beta\}\,. \tag{10}$$

$$\overline{apr}_P(SX) = \bigcup \{x \in U : \mu_{SX}(x) > 1 - \beta\}. \tag{11}$$

In this way, it is unnecessary to consider the membership function of fuzzy variables and the probability of random variables in structural reliability analysis, and the various types of uncertain variables are represented as unified variables of rough set, which facilitates the calculation greatly.

3.2. Rough set entropy attribute reduction

As mentioned earlier, MULCA algorithm is involved in coarsening and refinement of condensation, so that the computational complexity of the algorithm is improved, especially for classification problems with large data volume in sports aesthetics, how to reduce the computational complexity of the algorithm is related to the practical application value of algorithm. In the following, the rough set entropy attribute reduction will be used to preprocess the classification data, in order to reduce the computational complexity of algorithm and improve the accuracy of classification [8, 9].

Definition 6: (equivalence relation family) if $r \in R$, r is known as no-influence attribute item of R when $ind\,(R) = ind\,(R - \{r\})$, which can be ignored, otherwise, r is nonignorable item, where R equivalence relation set.

Definition 7: (attribute value definition) knowledge expression system: $S = \langle U, C, D, V, f \rangle$, U is domain of discourse, or known as collection of data objects, $R = C \cup D$ is as attribute set of rough set, C is condition attribute of rough set, D is decision attribute of rough set, $V = \bigcup_{r \in R} v_r$ represents attribute value domain, f is information function, $f : U \times R \to V$, that is $f\,(x, r) \in v_r$, represents attribute value of x on r.

Definition 8: (equivalence relation family) assumed that P and Q in U are equivalent, the P positive domain of Q can be expressed as:

$$pos_p\,(Q) = \bigcup_{X \in U/Q} P\,(X)\,. \tag{12}$$

In definition 8, the knowledge of U/P expression in U/Q positive field in the classification of U/P can be classified into the U/Q set through above definition correctly.

Definition 9: (attribute reduction) for known rough set information system $S = \langle U, A, V, f \rangle$, $B \subseteq A$ and $a \in B$: (1) if $I_B = I_{B-\{a\}}$, a is redundant attribute in data set, otherwise, it is nonignorable attribute; (2) if all the attributes in set B are nonignorable, B is independent, otherwise dependent; (3) if $B' \subseteq B$, and B' is independent, meeting $I_B = I_{B'}$, B' is known as the reduction of B.

All nonignorable items in data attribute set A make up $Core\,(A)$ of attribute set A, which is the intersection of all attributes in the attribute set A. The attribute reduction of rough set is an important step in data processing, which can effectively eliminate redundant attributes to simplify data processing load and reduce computational complexity.

Definition 10: (information entropy) assumed that $\{S_1', \cdots, S_v'\}$ is v subsets classified by information system S through attribute A, the entropy of this subset can be defined as:

$$E(A) = \sum_{j=1}^{v} \frac{S_j'}{S} \left[-\sum_{i=1}^{m} \frac{S_{ij}'}{S_j'} \log_2 \frac{S_{ij}'}{S_j'} \right], \tag{13}$$

where, S_{ij}' represents the number of individuals related to C_i category in S_j'. The information gain regarding attribute A can be expressed as:

$$Gain(A) = I(S_1, \cdots, S_m) - E(A). \tag{14}$$

Definition 11: (important measure) for the subset $Q \subseteq P$ of attribute set category C, its important measure represents the influence on U/C positive domain after removing attribute subset Q from attribute set P, which can be defined as:

$$sig(C) = r_P(C) - r_{P-Q}(C). \tag{15}$$

Definition 12: (entropy measure weight distance) assumed that there are K attributes, for its attribute $j \in K$, its importance weight can be defined as follows according to Definition 11:

$$\omega_j = sig(j) \Big/ \sum_{j=1}^{K} sig(j). \tag{16}$$

Then, the entropy measure weight distance can be defined as follows:

$$d(x_k, c_i) = \sum_{j=1}^{k} (\omega_j (x_{kj} - c_{ij}))^2. \tag{17}$$

Redundant attributes can be deleted by using the entropy measure weight distance, to effectively reduce the volume of calculating data, and can be trapped in the "dimension trap" through simulation algorithm, the steps of rough set entropy attribute reduction are as follows:

Step 1: enter database of n objects and the number k of output clusters;

Step 2: data initialization, assumed that $\gamma_\Phi = 0$, $\Phi \to red$;

Step 3: for any attribute $a_i \in A - red$, calculate important measure

$$sig(a_i, red, D) = \gamma_{red \cup a}(D) - \gamma_{red}(D). \tag{18}$$

Step 4: select the attribute a_k of the most important measure, meeting following formula:

$$sig(a_k, red, D) = \max(sig(a_i, red, D)). \tag{19}$$

Step 5: if $sig(a_k, red, D) > 0$, update the red set: $red \cup a_k \to red$, otherwise, return to Step 4;

Step 6: calculate individual attribute weight ω_j in red set by using the above

K-dimension database according to Definition 12;

Step 7: any k attribute objects are regarded as the cluster center;

Step 8: cycle the following steps:

(1) According to the mean value of cluster objects, objects are classified into similar cluster;

(2) Update the mean value of cluster and the mean value of objects in cluster;

(3) Calculate the entropy measure weight distance $d(x_k, c_i)$ until the $d(x_k, c_i)$ value is stable.

Step 9: output red, attribute cluster and $d(x_k, c_i)$.

3.3. Evaluation process of sports aesthetics of improved MULCA algorithm

For the analysis of sports aesthetic with large data volume, reducing data redundancy is particularly important for the practical application of the algorithm [10]. The main idea of this section is data preprocessing based on rough set entropy attribute reduction. Steps for sports aesthetics analysis based on improved MULCA algorithm:

Step 1: enter the sports aesthetics data set X to be classified and the number K of clusters required;

Step 2: preprocess the sports aesthetic data set X by rough set entropy attribute reduction step in Section 3.1, output the number $k = K$ of clusters, calculate and output red, attribute cluster and entropy measure weight distance $d(x_i, x_j)$;

Step 3: replace the similarity definition of Definition 1 with the entropy measure weight distance $d(x_i, x_j)$, given $\mu(x_i, x_j) = d(x_i, x_j)$, the data set reduced by the rough set entropy attribute is used as the input data set X' of the algorithm;

Step 4: calculate and output similarity matrix $\left\{X_\alpha^1, X_\alpha^2, \cdots, X_\alpha^m\right\}$ and $\{P_{1,2}, P_{2,3}, \cdots, P_{m-1,m}\}$ of the data set X';

Step 5: classify the data set, and output the final classification results of sports aesthetics data.

4. Result analysis

The preliminary evaluation index system of aesthetic value is shown in Table 2.

Table 2. Preliminary evaluation index system of aesthetic value

Item	Index
Aesthetic value	Openness
	Hierarchy
	Novelty
	Diversity

According to the definition of sports aesthetics index, sports aesthetics indexes of the five scenic spots of Longshan Forest Park can be obtained, and are ranked according to their comprehensive scores. The results are shown in Table 3.

Table 3. Ranking table of sports aesthetic index

Ranking	Sports events	Aesthetic index
1	Dance	6.658
2	Artistic skating	5.523
3	Aerobics	5.862
4	Artistic gymnastics	5.743
5	Martial arts	4.216

It can be clearly seen from Table 3 that the sports aesthetic index of dance is the highest, and that of martial arts is the lowest. However, according to the classification of sports aesthetic index, it can be known that the sports aesthetic level of dance and artistic skating is III, that is general, and the sports aesthetic level of aerobics, artistic gymnastics and martial arts is IV, that is poor.

The following is mainly to test the influence of algorithm clustering time and data numbers, dimensions and clusters on the running time of the algorithm, and the simulation results are shown in Fig. 1.

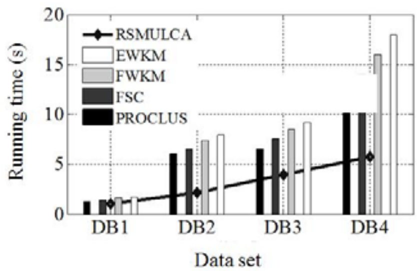

Fig. 1. Comparative result of running time

Fig.1 shows the comparison of running time of several algorithms, from which it can be seen that the RSMULCA algorithm in this paper is superior to the applied comparing algorithm in the running time, for which the main reason is that the rough set entropy attribute reduction algorithm is used for RSMULCA algorithm, which helps to reduce the calculated amount of classification data. The running time of other several algorithms: PROCLUS is superior to FCS algorithm, and both are superior to EWKM and FWKM algorithm, while FWKM is superior to EWKM algorithm, for which the main reason is that the parameter determination of the EWKM algorithm needs more complicated calculation steps.

5. Conclusion

This paper proposes an evaluation method for sports aesthetics based on the MULCA algorithm of rough set entropy attribute reduction under the trend of sports art, and provides the sports aesthetics index classification standard table, and achieves effective evaluation for to sports aesthetics by using the designed MULCA algorithm of rough set entropy attribute reduction. The proposed method can be used to guide the programming of art sports programs.

References

[1] Dan S D, Li O Z, Tsang A, et al. (2011) *Voluntary Nonfinancial Disclosure and the Cost of Equity Capital: The Initiation of Corporate Social Responsibility Reporting*[J]. Social Science Electronic Publishing, 86(1):59-100.

[2] Nores M, Barnett W S (2012) *Benefits of early childhood interventions across the world: (Under) Investing in the very young*[J]. Economics of Education Review, 29(2):271-282.

[3] Richards G (2011) *Creativity and tourism : The State of the Art[J]. Annals of Tourism Research*, 38(4):1225-1253.

[4] Grabow M, Spak S, Holloway T, et al. (2012) P-249:, *Air Quality and Exercise-Related Health Benefits from Reduced Car Travel in the Midwestern United States.*[J]. Epidemiology, 23(5S):68-76.

[5] García-Llorente M, Martín-López B, Iniesta-Arandia I, et al. (2012) *The role of multi-functionality in social preferences toward semi-arid rural landscapes: An ecosystem service approach*[J]. Environmental Science & Policy, 19-20(5):136-146.

[6] Travassos B, Araújo D, Davids K, et al. (2012) *Informational constraints shape emergent functional behaviours during performance of interceptive actions in team sports*[J]. Psychology of Sport & Exercise, 13(2):216-223.

[7] Cutting J E, Brunick K L, Delong J E, et al. (2011) *Quicker, faster, darker: Changes in Hollywood film over 75 years*[J]. i-Perception, 2(6):569-576.

[8] Myers J P, Gomez T M (2011) *Focal adhesion kinase promotes integrin adhesion dynamics necessary for chemotropic turning of nerve growth cones.*[J]. Journal of Neuroscience the Official Journal of the Society for Neuroscience, 31(38):13585-13595.

[9] Shapin S (2012) *The sciences of subjectivity.*[J]. Social Studies of Science: An International Review of Research in the Social Dimensions of Science and Technology, 42(2):170-184.

[10] Robinson P M, Wilson J, Dalal S, et al. (2013) *Rotator cuff repair in patients over 70 years of age: early outcomes and risk factors associated with re-tear*[J]. Bone Joint J, 95-B(2):199-205.

[11] Shuck, Brad|Herd, Ann Mogan (2012) *Employee Engagement and Leadership: Exploring the Convergence of Two Frameworks and Implications for Leadership Development in HRD.*[J]. Human Resource Development Review, 11(2):156-181.

[12] Mchayhurst L, Darnell S C, Black D R (2011) *Corporatising sport, gender and development: postcolonial IR feminisms, transnational private governance and global corporate social engagement.*[J]. Third World Quarterly, 32(3):531-549.

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